REMARKS

Within the Office Action, Claims 1-4 and 14 are rejected under 35 U.S.C 102(b) as being anticipated by U.S. Patent 2,746,813 to Massa (hereinafter "Massa"). In addition, Claims 16 and 17 are rejected under 35 U.S.C. 103(a) as unpatentable over Massa in view of U.S. Patent 4824,262 to Kamigaito et al. The Applicants respectfully traverse. In addition, the Applicants have added new independent claims 143 and 144. Therefore, Claims 1-4, 14, 16, 17, 143 and 144 are currently pending.

Rejections Under 35 U.S.C. 102(b)

Specifically, it is stated within the Office Action that Massa teaches a method of controlling an effective coefficient of friction between a first surface of a first element and a second surface of a second element. In addition, it is stated within the Office Action that Massa teaches that the first and second surfaces are configured to be in slidable contact with one another along an interface between the first surface and the second surface and under a force sufficient to maintain contact and having a static friction therebetween. It is also stated within the Office Action that Massa teaches, in column 1, lines 66-69, inducing a symmetrical and repetitive motion in the first surface parallel to the interface, thereby altering the effective coefficient of friction. The Applicants respectfully disagree.

The present invention is directed to a method of controlling an effective coefficient of friction along an interface between the surfaces of two mating elements. Specifically, the present invention utilizes a repetitive or symmetrical motion in the surfaces of one of the two elements such that the effective coefficient of friction between the two surfaces is altered. In addition, the present invention externally supplies most of the energy that is dissipated by the frictional sliding process caused by two surfaces sliding against one another. The external supply of the energy thereby causes an apparent alteration of the coefficient of friction, which is referred to as a alteration in the "effective coefficient of friction" or μ_{SB}.

Massa teaches a body employing high frequency compressional waves which reduces the amount of static friction between two smooth surfaces. Massa teaches that by using high frequency compressional waves, a high oscillatory velocity can be established between the two smooth mating pairs without the necessity of using large amplitudes. Massa also teaches imparting high velocity, low amplitude oscillatory vibrations at the interface of two mating smooth surfaces so that the static friction is greatly reduced while the resulting displacement produced at the interface is less than one tenth of a thousandth of an inch. In contrast to the

present invention, Massa does not teach that an effective coefficient of friction between the first surface and the second surface is controlled or altered. In addition, Massa does not teach, hint or suggest that the element which is energized is moving in a repetitive motion. Instead, all that is taught in Massa is that the high velocity oscillatory vibrations are imparted to the interface. For at least these reasons and the reasons stated below, Massa does not teach the present invention.

There is a substantial difference between controlling the static friction force F_μ between two surfaces, as in Massa, and controlling the effective coefficient of friction μ_{SB} between two surfaces, as in the present invention. As known in the art, static frictional forces F_μ, are present at the interface between two objects, whereby one of the objects is moving with respect to the other. Also, as known in the art, to move the object, the amount of force applied to the object being moved must be greater than the static friction force F_μ which opposes the applied force. As stated above, Massa teaches that the static friction force F_μ between the two elements is reduced such that less applied force is needed to move the object. In contrast to Massa, the present invention conceptually applies a supplemental force F_{SUPP} to the applied force such that less applied force is needed to initiate movement of the object although the static friction force F_μ does not change. In other words, the present invention requires less force to move the object without changing the static friction force between the two surfaces of the objects. Therefore, in the present invention, the static friction force F_μ is not reduced, but instead the effective coefficient of friction μ_{SB} is altered.

This alteration in the effective coefficient of friction μ_{SB}, while leaving the actual static friction F_μ unaltered, is addressed and described in the specification of the present application. As will be shown, the frictional power dissipations W between surfaces where the static friction force F_μ is reduced is different than the frictional power dissipations W between surfaces where the effective coefficient of friction μ_{SB} is altered. Specifically, Figure 11A in the present specification illustrates the relationship between the effective coefficient of friction, μ_{SB}, and the root mean square (r.m.s.) velocity of the first element, whereby the effective coefficient of friction μ_{SB} decreases as the r.m.s. velocity of the first element increases. In addition, Figure 12A in the present specification illustrates the relationship between the frictional power loss or power dissipations, W, and the r.m.s. velocity of the first element, whereby the amount of frictional power dissipations W increase with the r.m.s. velocity of the first element.

As known in the art, smaller static friction forces F_μ between two surfaces in contact with one another produces lower power dissipations W between the surfaces when one of the surfaces is vibrating at a given r.m.s. velocity. In contrast, larger static friction forces F_μ between the same two surfaces in contact with one another produces higher power dissipations W for the

same given r.m.s. velocity. Since Massa teaches that the static friction force F_μ is reduced between the surfaces of the two elements, the power dissipations W decrease between the two surfaces with increasing r.m.s. velocity of the vibrating element. Similarly, if the static frictional force F_μ between the two surfaces in the present invention were to be reduced, then the power dissipations W would also decrease with increasing r.m.s. velocity of the vibrating element. However, as shown in Figure 12A in the specification of the present invention, the power dissipations W increase linearly with the r.m.s. velocity of the vibrating element. This is because in the present invention, the amount of static friction F_μ between the two surfaces is unaltered and only the effective coefficient of friction μ_{SB} is altered. As contended in the Office Action, if the static frictional force F_μ between the two surfaces in the present invention were to be decreased, then the power dissipations W for the given external load would not increase linearly with the increasing r.m.s. velocity. However, this is not the case in the present invention. Therefore, as shown in the specification of the present invention, alteration of the effective coefficient of friction μ_{SB} is substantially different than the reduction of the static frictional force F_μ between two surfaces.

An example of the concept in the present invention can be found in an automobile's power steering. The purpose of power steering is to aid the driver in turning the steering wheel, especially when the automobile is not moving and overcoming the static friction forces present between the automobile tires and the road. Specifically, in automobiles having power steering, an external energy is supplied by the car engine to the steering assembly, whereby the external energy allows the steering wheel to turn easily. However, the static friction forces between the tires and the road are not altered by the presence of the extra energy applied to the steering assembly. In contrast, Massa, using the same example, would teach applying ice between the road and tire such that the static friction force between the road and the tire is reduced. As shown, the two concepts are substantially different from one another. For at least the reasons stated above, since Massa merely teaches a reduction in the static frictional force F_μ and not an alteration of the effective coefficient of friction μ_{SB}, the present invention is distinguishable over Massa.

Claim 1 is directed to a method of controlling an effective coefficient of friction between a first surface of a first element and a second surface of a second element, the method comprising the steps of configuring the first and second surfaces to be in slidable contact with one another along an interface between the first surface and the second surface and under a force sufficient to maintain contact and having a static friction therebetween; and inducing a repetitive motion in the first surface parallel to the interface thereby altering the effective coefficient of friction. As

stated above, Massa does not teach controlling nor altering an effective coefficient of friction μ_{SB} between the first and second surfaces. Instead, Massa teaches that the static frictional force F_μ is reduced between the first and second surfaces. As discussed above, reducing the static friction force F_μ is substantially different than altering the effective coefficient of friction μ_{SB} between the two surfaces. In addition, Massa does not teach, hint or suggest that the element which is energized is moving in a repetitive motion, as claimed in Claim 1. For at least these reasons, the present invention is distinguishable over Massa. Therefore, Claim 1 is in a condition for allowance.

Claim 2 is directed to a method of controlling an effective coefficient of friction between a first surface of a first element and a second surface of a second element, the method comprising the steps of configuring the first and second surfaces to be in slidable contact with one another along an interface between the first surface and the second surface and under a force sufficient to maintain contact and having a static friction therebetween; and inducing a symmetrical motion in the first surface parallel to the interface thereby altering the effective coefficient of friction. As stated above, Massa does not teach controlling nor altering an effective coefficient of friction μ_{SB} between the first and second surfaces. Instead, Massa teaches that the static frictional force F_μ is reduced between the first and second surfaces. As discussed above, reducing the static friction force F_μ is substantially different than altering the effective coefficient of friction μ_{SB} between the two surfaces. In addition, Massa does not teach, hint or suggest that the element which is energized is moving in a symmetrical motion, as claimed in Claim 2. For at least these reasons, the present invention is distinguishable over Massa. Therefore, Claim 2 is in a condition for allowance.

Claims 3, 4 and 14 are also rejected under Massa, however Claims 3, 4 and 14 are dependent on an allowable independent Claim 2. As stated above, Claim 2 is in a condition for allowance. Accordingly, Claims 3, 4 and 14 are also in a condition for allowance.

Rejection Under 35 U.S.C. 103(a)

Claims 16 and 17 were rejected under 35 U.S.C. 103(a) as being unpatentable over Massa in view of Kamigaito et al. However Claims 16 and 17 are dependent on an allowable independent Claim 2. As stated above, Claim 2 is in a condition for allowance. Accordingly, Claims 16 and 17 are also in a condition for allowance.